INTRODUCTION

Recovery Unit Designation

In Washington, to facilitate the recovery planning process and avoid duplication of effort, the recovery team adopted the logistical framework proposed in the 1999 draft Statewide strategy to recover salmon, "Extinction Is Not An Option" (Washington Governor's Salmon Recovery Office (WGSRO) 1999). Based on this draft strategy, bull trout recovery units overlap the State's salmon recovery regions. The identification of a Lower Columbia, Middle Columbia, Upper Columbia, Snake, and Northeast Washington recovery units allows for better coordination between salmon and bull trout recovery planning and implementation. The Middle Columbia River Recovery Unit is one of 22 recovery units designated for bull trout in the Columbia River Distinct Population Segment (Figure 1).

Figure 1. Bull Trout Recovery Units in the United States. **The Middle Columbia Recovery Unit is highlighted.**

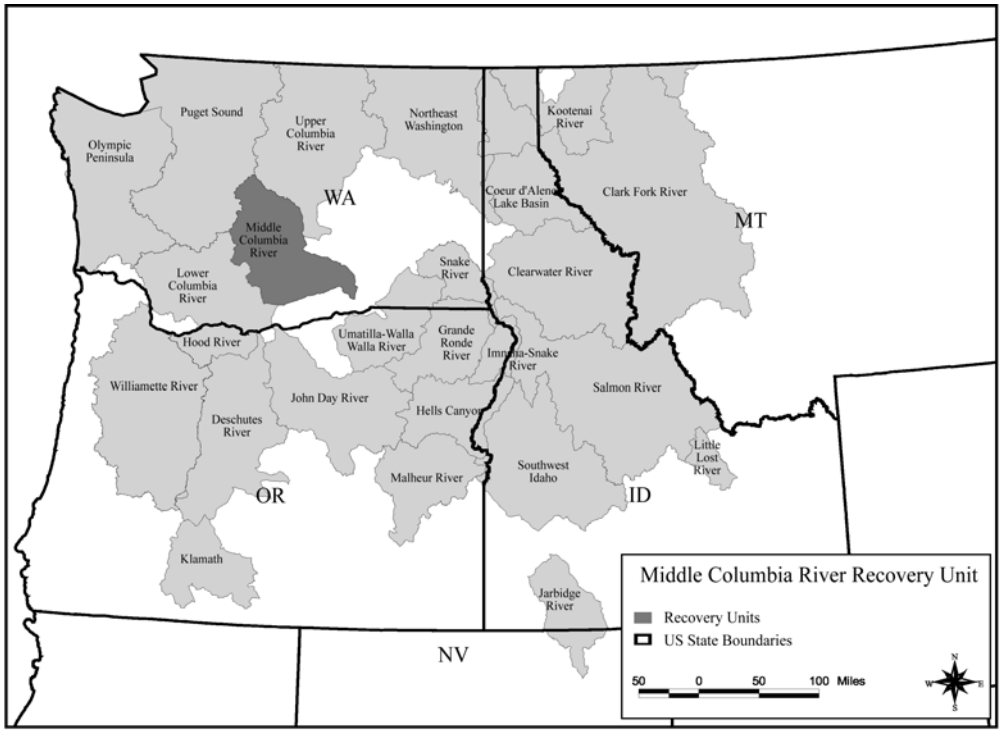
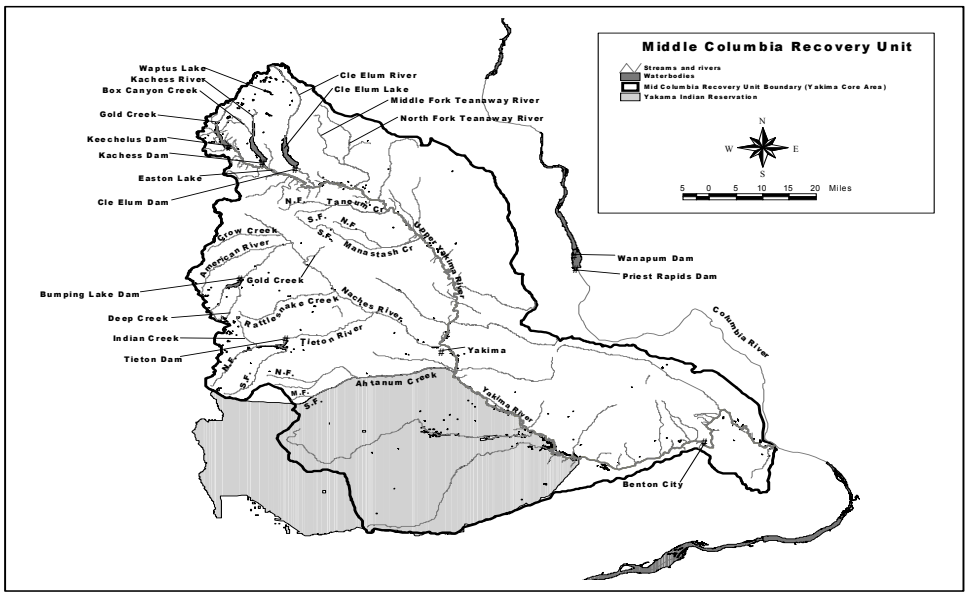


Figure 2. Middle Columbia Recovery Unit (encompasses the Yakima River basin, which is also the Yakima Core Area) and selected tributaries.



The Middle Columbia Recovery Unit Team identified one core area (Yakima River basin) within the recovery unit (Figure 2). Based on survey data and professional judgement, the Middle Columbia Recovery Unit Team also identified local populations of bull trout within the core area.

The Middle Columbia Recovery Unit geographically overlaps ceded lands of the Yakama Nation. The Yakama Nation have guaranteed Treaty fishing rights for both anadromous and resident fish species. When the Middle Columbia River Recovery Unit has achieved its goal, the Washington Department of Fish and Wildlife and the Yakama Nation will determine the location and level of bull trout harvest which can be sustained while maintaining healthy populations.

Geographic Description

The Middle Columbia Recovery Unit encompasses the Yakima River basin, which is also the identified Yakima Core Area. The Yakima River basin is located in south central Washington, draining approximately 15,900 square kilometers (6,155 square miles) (Washington Department of Fish and Wildlife (WDFW) 1999;

Northwest Power Planning Council (NPPC) 2001) into the Columbia River. The basin occupies most of Yakima and Kittitas counties, about half of Benton County and a small portion of Klickitat County. It is bounded on the west by the Cascade Range, on the north by the Wenatchee Mountains, on the east by the Rattlesnake Hills, and on the south by the Horse Heaven Hills. The entire basin lies within areas either ceded to the United States by the Yakama Nation or areas reserved for their use. The Yakima River basin lands are some of the most intensively irrigated in the United States with approximately 26,325 hectares (65,000 acres) of irrigated land. Other major land use activities include livestock operations (grazing, feedlots, dairies) and timber production/harvest.

The Yakima River flows southeasterly for about 344 kilometers (214 miles) from its headwaters in the Cascade Range to its confluence with the Columbia River near Richland, Washington (NPPC 2001). Altitudes in the basin range from 2,496 meters (8,184 feet) above mean sea level in the Cascades to 104 meters (340 feet) at the confluence. The Naches River is the largest tributary of the Yakima River, flowing 72 kilometers (45 miles) to its confluence at the City of Yakima. The Naches River forms at the confluence of the Bumping, American, and the Little Naches rivers. Its' major tributaries are Rattlesnake Creek and the Tieton River. Major tributaries of the upper Yakima River (above the Naches confluence) include the Kachess, Cle Elum, and Teanaway rivers. The major tributaries of the lower Yakima River include Toppenish and Satus Creeks, both originate on the Yakama Indian Reservation, and Ahtanum Creek. Numerous small streams contribute seasonal flows to rivers within the basin.

The climate of the Yakima River basin ranges from alpine along the crest of the Cascade Range to arid in the lower valleys (NPPC 2001). The mountainous western and northern parts of the basin receive precipitation principally as snow from November through March, and as rain during the remainder of the year. The eastern portion of the basin receives some snowfall but the majority of the precipitation falls as rain between October and March. Precipitation varies considerably across the basin throughout the year. Mean-annual accumulations range from about 325 centimeters (128 inches) in the higher elevations of the mountains to less than 20 centimeters (8 inches) in the far eastern half of the basin

(System Operations Advisory Committee (SOAC) 1999). Air temperatures in the basin are inversely related to altitude. In general, summer air temperatures are warm in the mountains to hot in the lower elevation areas of the basin; winters are cold throughout the basin. Minimum and maximum mean monthly temperatures occur in January and in July, respectively.

There are five major storage reservoirs in the Yakima River basin; Keechelus, Kachess, and Cle Elum reservoirs are located in the upper Yakima Basin, while Bumping and Rimrock Reservoirs are located in the upper Naches River. These reservoirs have a total storage capacity of about 1 million acre-feet (SOAC 1999). In addition, there are numerous irrigation diversion dams. These features have severely altered the natural hydrographs of the rivers in the Yakima River basin. These altered hydrographs are now characterized by much lower than normal winter flows, as water is stored for the next years' use, and much higher than normal summer flows, as water is delivered in-channel to various diversion points for irrigation. During the run-off period in the spring, high flows still occur during most years but the magnitude of these flows is greatly reduced relative to what would have occurred naturally. During the winter and early spring, high flows may also occur when water is released from the reservoirs during flood control operations. The annual estimated unregulated runoff of the Yakima River at the Parker Gauging Station (in the lower river) averages 3.5 million acre-feet (SOAC 1999). The average annual irrigation diversion requirements are approximately 2.2 million acre-feet. Approximately 375,000 acre-feet returns as irrigation return flow in a normal water year (U.S. Bureau of Reclamation (USBR) 1999).

DISTRIBUTION AND ABUNDANCE

Status of Bull Trout at the Time of Listing

In the final listing rule (63 FR 31647) the U.S. Fish and Wildlife Service identified eight bull trout subpopulations in the Yakima River basin (U.S. Fish and Wildlife Service (USFWS) 1998). These subpopulations included; Ahtanum Creek, Naches River, Rimrock Lake, Bumping Lake, North Fork Teanaway River, Cle Elum Lake , Kachess Lake, and Keechelus Lake. At the time of listing (June 1998), only the Rimrock Lake subpopulation was considered stable. The remaining subpopulations were classified as depressed and declining. The population status for the Naches River subpopulation was classified as unknown. With the exceptions of the Rimrock Lake and Naches River the remaining subpopulations were considered to be at risk of extirpation.

The U.S. Fish and Wildlife Service considers isolation by dams to be a major threat to bull trout in the basin and considers agricultural practices and associated water withdrawal as a threat to each subpopulation. Additional threats facing bull trout subpopulations in the basin included, forestry, grazing, roads, mining, harvest, nonnative species, and residential development. Although subpopulations were an appropriate unit upon which to base the 1998 listing decision, the recovery plan has revised the biological terminology, to better reflect both the current understanding of bull trout life history and conservation biology theory. Therefore, subpopulation terms will not be used in this chapter. Habitat and population terminology is found in Chapter 1.

Current Distribution and Abundance

Historically, bull trout occurred throughout the Yakima River basin, but they are now fractured into isolated populations (WDFW 1998). Bull trout in the Yakima Core Area are currently found in 13 local populations including: the mainstem Yakima River (Keechelus to Easton Reach); Ahtanum Creek (North, South, and Middle forks); Naches River tributaries (American River, Rattlesnake Creek, and Crow Creek); Rimrock Lake tributaries (South Fork Tieton River and

Indian Creek; Bumping Lake (Deep Creek); North Fork Teanaway River; Kachess Lake tributaries (Box Canyon Creek and the upper Kachess River); Keechelus Lake (Gold Creek); and the upper Cle Elum River.

Fragmentation of habitat in the Yakima Core Area impedes bull trout migration and has resulted in restricted distribution. Historically, bull trout were once more widely distributed, and migration into the lower Yakima River to forage and overwinter was likely (WDFW 1998). One bull trout was encountered by Washington Department of Fish and Wildlife research biologists in 1997, in the lower Yakima River near Benton City (WDFW 1998). In 1993, a single bull trout was captured in a trap in Swauk Creek, near the confluence with the Yakima River (WDFW 1998). Old catch records indicate the presence of bull trout in other lower Yakima River tributaries including Satus Creek, Cowiche Creek, and Coleman Creek (WDFW 1998). A survey in 2001, in a tributary to Cowiche Creek documented a single 10 centimeter (4 inch) bull trout (Anderson, E. *in litt.* 2002).

Mainstem Yakima River

Incomplete bull trout spawning ground surveys in the Keechelus Lake to Easton Lake reach of the mainstem Yakima River found two redds in 2000, and a single redd in 2001 (Table 1). Based on this documented spawning activity, the Middle Columbia Recovery Unit Team identified this area as supporting a bull trout local population. In 1996, one 545 millimeter (21 inch) bull trout was caught in Easton Lake (a 238-acre reservoir of the upper Yakima River) (WDFW 1998). The few fish that have been caught in recent years range in size from 305 to 559 millimeters (12 to 22 inches) (WDFW 1998). Only a few bull trout have been found since intensive field monitoring of populations in the upper Yakima River mainstem began in 1990. Electrofishing surveys conducted annually during September and October between Roza Dam and Cle Elum have only identified four bull trout in the Yakima River.

Ahtanum Creek

Bull trout in the Ahtanum Creek local population originated from native fluvial or resident life history forms that occurred throughout the Yakima River (WDFW 1998). Currently, they are seasonally isolated from fish in the Yakima River due to thermal barriers and total dewatering (July through October) of lower Ahtanum Creek below River kilometer 32 (River Mile 19.7) by irrigation water withdrawals (WDFW 1998). Bull trout have been encountered below this diversion during mid-April when water is available.

Although bull trout are present in the mainstem Ahtanum Creek they are probably more abundant in the upper portion of the drainage, particularly in the North, Middle and South forks where habitat conditions are more favorable (WDFW 1998). Surveys conducted since 1993 in the North Fork Ahtanum Creek only found 5 to 20 redds annually (Table 1). Incomplete surveys in the South and Middle forks indicate that bull trout in these areas also persist at very low abundance levels (WDFW 1998). The majority of adult spawners range from 200 to 356 millimeters (8 to 14 inches) in total length (WDFW 1998). The Ahtanum Creek local population most likely consists of both resident and fluvial forms and more research is needed to better define the interaction between the two forms. Removal of low water migration barriers within the system would allow for a full expression of the fluvial life history form.

Table 1. Summary of bull trout spawning surveys (redd counts) in index areas of the Yakima Core Area, 1984 to 2001. Data provided by the Washington Department of Fish and Wildlife.

Stream	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Yakima River																		
Keechelus to Easton Reach	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	2*	1*
Ahtanum Creek																		
N.F. Ahtanum Cr. (Shellneck Cr.)	___	___	___	___	___	___	___	___	___	9	14	6	5	7	5	7	11	20
M.F. Ahtanum Cr.	___	___	___	___	___	___	___	___	___	___	___	___	1*	1*	___	0*	10*	1*
S.F. Ahtanum Cr.	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	5*	14*
Naches River																		
Rattlesnake Cr. (Little Wildcat Cr.)	___	___	___	___	___	___	2*	___	___	___	4*	26*	38	46	53	44	45	57
American R. (Union Cr., Kettle Cr.)	___	___	___	___	___	___	___	___	___	___	___	___	25	24	31	30	44	36
Crow Cr.	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	19	26	6
Rimrock Lake																		
S.F. Tieton R. (Bear Cr.)	___	___	___	___	___	___	32*	___	___	38*	167	95	233	177	142	161	144	158
Indian Cr.	29*	69*	16*	35*	25	39	69	123	142	140	179	201	193	193	212	205	226	117

Stream	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Bumping Lake																		
Deep Cr.	___	___	___	___	___	17*	15*	84	78	45	12	101	46	126	98	107	147	51
N.F. Teanaway River																		
NF Teanaway/DeRoux Cr.	___	___	___	___	___	___	___	___	___	___	___	___	2*	0*	0*	___	0*	0*
Kachess Lake																		
Box Canyon Cr.	5	4	3	0	0	0	5	9	5	4	11	4	8	10	16	17	10	14
Kachess R (upper)															0*		15	14
Keechelus Lake																		
Gold Cr.	2	2	21	15	12	3	11	16	14	11	16	13	51	31	36	40	19	15
Cle Elum Lake																		
Cle Elum R. (upper)	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	___	7*	0*

* Incomplete survey; index area not fully defined or adequately monitored. Redds in small tributaries (parenthesis) included in the total stream count.

Naches River

Based on spawning ground surveys, bull trout local populations have been identified in Rattlesnake Creek (including Little Wildcat Creek), American River (including Union and Kettle creeks), and Crow Creek (Table 1). Spawning fish range in size from 200 to 457 millimeters (8 to 18 inches) in Rattlesnake Creek. Larger bull trout adults, greater than 500 millimeters (20 inches), have been observed spawning in the American River (WDFW 1998).

In addition, bull trout have been found in the Tieton River (below Rimrock Lake), Little Naches River, the Bumping River (below Bumping Lake), and other small tributaries (WDFW 1998). Recent U.S. Forest Service surveys found one bull trout in Oak Creek, and one in Milk Creek (WDFW 1998; Anderson, E. *in litt*. 2001a).

Consistent redd surveys by the Washington Department of Fish and Wildlife and the U.S. Forest Service have been conducted in Rattlesnake Creek and the American River since 1996. Redd counts in Rattlesnake Creek have ranged from 38 to 57, while the American River has varied from 24 to 44 redds annually. Only 3 years of survey data are available for Crow Creek and the number of redds has been variable (6 to 26).

Rimrock Lake

Local populations of bull trout are found in the South Fork Tieton River (including Bear Creek) and Indian Creek. These fish most likely originated from native fluvial fish in the Tieton River. Construction of the Tieton Dam in 1925 forced bull trout to adopt a adfluvial life history pattern (WDFW 1998). Spawning occurs in Indian Creek and the South Fork Tieton River from late August to early October although bull trout appear to stage in the South Fork Tieton as early as June and July. Juvenile bull trout have been observed in several other South Fork Tieton tributaries including Short, Dirty, Grey, Spruce and Corral creeks. The majority of adult spawners range from 457 to 610 millimeters (18 to 24 inches) in total length (WDFW 1998).

Based on spawning ground surveys the South Fork Tieton River and Indian Creek represent the strongest remaining bull trout local populations in the Yakima Core

area (Table 1). Since 1996, redd counts in the South Fork Tieton River and Indian Creek have averaged 169 and 191, respectively.

Catch records for Clear Lake on the North Fork Tieton documented bull trout presence in the 1950's (WDFW 1998). In 1993, U.S. Forest Service staff reported capturing one 75 to 100 millimeter (3 to 4 inch) bull trout from a minnow trap in Clear Lake. In addition, biologists from Central Washington University observed an adult bull trout in the upper North Fork Tieton River in 1996 (WDFW 1998). In the last 4 years Washington Department of Fish and Wildlife has been working with Central Washington University to monitor the Rimrock Lake bull trout. Based upon initial indications of run timing and tagging work, it appears that Indian Creek and South Fork Tieton River fish may be two distinct spawning populations (WDFW 1998).

Bumping Lake

Adfluvial bull trout inhabit Bumping Lake and are part of the local population in Deep Creek (WDFW 1998). The local population in Deep Creek probably originated from a native adfluvial life history form, which was present even before the construction of the dam in 1910. Construction of the dam enlarged the natural lake and forced any fluvial bull trout to adopt an adfluvial life history. While Deep Creek is the only identified local population above Bumping Lake, the U.S. Forest Service reported a single redd with three bull trout in the upper Bumping River in 1994 (MacDonald, K. *in litt*. 2001). Spawning in Deep Creek occurs from late August to mid-September and the majority of adult spawners range from 457 to 610 millimeters (18 to 24 inches) in total length (although larger fish have been observed during spawning surveys). Since 1996, annual redd surveys have averaged 96 redds.

North Fork Teanaway River

The bull trout local population in the North Fork Teanaway includes the mainstem and DeRoux Creek. Limited spawning ground surveys since 1996 have found only two redds (Table 1). Bull trout have also been observed in Jungle and Jack creeks (WDFW 1998). Although the habitat appears to be suitable for bull trout in the West and Middle forks, no bull trout have been found in these streams. Bull trout in

the North Fork are likely a mix of both small resident forms and larger fluvial forms. Snorkel surveys conducted in 1994 and 1997, sampled 54 and 10 bull trout, respectively (WDFW 1998).

Kachess Lake

Extant bull trout local populations above Kachess Dam probably originated from a native adfluvial life history form, which was present in the existing lake before the construction of the dam in 1905 (WDFW 1998). Local populations identified by the Middle Columbia Recovery Unit Team include Box Canyon Creek and the upper Kachess River. However, some spawning may occur in Mineral Creek when adequate flows are available (WDFW 1998). Spawning ground surveys conducted since 1984 in Box Canyon Creek indicates that the population persists at a low abundance level (Table 1). Since 1996, approximately 12 redds per year have been found in Box Canyon Creek. In the upper Kachess River, spawning ground surveys conducted in 2000 and 2001 found 15 and 14 redds, respectively. The majority of adult spawners range from 457 to 610 millimeters (18 to 24 inches) in total length (WDFW 1998).

Keechelus Lake

Similar to Kachess Lake, bull trout in the Gold Creek local population most likely originated from a native adfluvial life history form which was present before the construction of the dam and irrigation reservoir in 1914 (WDFW 1998). Adult bull trout spawning in Gold Creek has been observed from early September to early October. Anecdotal reports indicate that bull trout may have been present in Rocky Run Creek in the early 1980's. However, surveys to confirm their presence have not been conducted. Spawning ground surveys for the Gold Creek local population have been conducted since 1984. Since 1996, surveys in the Gold Creek local population have documented an average of 32 redds annually (Table 1).

Adult spawners range in size from 457 to 610 millimeters (18 to 24 inches), although smaller fish have been observed on redds (WDFW 1998). Limited information indicates the age composition of the spawning population is 4 to 10 years

of age with a sex ratio of 1:1 and fecundity of several thousand eggs per adult female (WDFW 1998).

Upper Cle Elum River

The Middle Columbia Recovery Unit Team has identified one local population above Cle Elum Dam. Similar to other areas within the Yakima Core Area these bull trout most likely originated from a native adfluvial life history form which was present even before the construction of the dam in 1931 (WDFW 1998). Construction of the dam enlarged the natural lake and forced any fluvial bull trout stock to adopt an adfluvial life history pattern. Limited redd survey data indicates that the local population is at very low abundance (Table 1).

The National Marine Fisheries Service captured 17 fish ranging in size from 150 to 400 millimeters (6 to 16 inches) in traps set in Cle Elum Lake from 1990 to 1993 (WDFW 1998). Biologists from Central Washington University observed several adult bull trout in the upper Cle Elum River in late August of 1996 (WDFW 1998).

Catch records compiled by the Washington Department of Fish and Wildlife indicate that bull trout were present in Waptus Lake in the 1940's and early 1950's (WDFW 1998). Washington Department of Fish and Wildlife biologists recently confirmed the presence of bull trout in Waptus Lake by capturing a single juvenile fish in a gill net in 1996. In 1997, biologists also captured and released a large adult bull trout. It is not known if any relationship, exists between bull trout inhabiting Waptus Lake and the local population in the upper Cle Elum River. A waterfall located on the lower Waptus River between Waptus and Cle Elum lakes may act as a barrier to bull trout migration between the two systems (WDFW 1998). Additional surveys are needed to determine if additional local populations exist in the Waptus River system.

REASONS FOR DECLINE

Dams

Of the five major storage reservoirs in the Yakima Core Area (Kachess, Keechelus, Cle Elum, Bumping, and Rimrock), all but Rimrock Lake (Tieton Dam), were historically natural lakes. The dams built across the lake outlets greatly enlarged their surface area and flooded large areas of stream habitat. None of these dams were constructed with fish passage facilities, a condition that still exists today. The impacts of the irrigation storage dams are related to both the structures themselves and the operation of the facilities. Potential impacts from each facility include: 1) fragmentation of populations, 2) entrainment, 3) altered water temperature, 4) reservoir passage, and 5) altered basin flow regimes.

Fragmentation of Populations

Existing dams within the Yakima Core Area have fragmented bull trout populations, prevented genetic exchange, and eliminated the possibility for reestablishment (WDFW 1998; Snyder and Stafford 2001). Historically, the Yakima Core Area consisted of an interconnected system of lentic and lotic environments through which bull trout freely moved. Fluvial bull trout in the Middle Columbia Recovery Unit, may have migrated seasonally from spawning tributaries downstream into the lower Yakima and Columbia rivers to overwinter and feed because bull trout in other Columbia River tributaries (*e.g.*, Hood and Wenatchee rivers) are known to migrate downstream as part of their normal life history strategies (Oregon Department of Fish and Wildlife (ODFW) 1997; Kelly-Ringel and De La Vergne 2001; Kreiter 2001). Fragmentation of local populations is recognized as a contributing factor in the decline of bull trout (Rieman and McIntyre 1993; Washington Department of Wildlife (WDW) 1992; Craig and Wissmar 1993).

For purposes of bull trout recovery planning, the metapopulation theory is an important consideration in evaluating connectivity between local populations. A metapopulation is an interacting network of local populations with varying frequencies of migration and gene flow among them (Meffe and Carroll 1994).

Multiple local populations distributed and interconnected throughout a watershed provide a mechanism for spreading risk from stochastic events (see Chapter 1). As defined, bull trout core areas reflect metapopulation theory, and a recovered condition for the Yakima Core Area needs to include the reconnection of local populations. In addition, reconnecting local populations within the Yakima Core Area would assist in meeting effective population size criteria, and minimizing the deleterious effects of genetic variation due to drift (see Chapter 1).

Entrainment

Entrainment in the unscreened outlet works of each storage dam in the basin is a concern. Bull trout that enter these submerged intake structures are entrained with injury or mortality as a potential outcome (USBR 2000). In an ongoing entrainment study being conducted directly below Tieton Dam, four dead sub-adult bull trout were collected in nets during September 2001. With extrapolation based on tests of sampling efficiency, between 46 and 87 were likely flushed from Rimrock Reservoir. Approximately 11,281 kokanee, the primary prey species for bull trout in the reservoir, were entrained in the outlet works of the dam. Over 80 percent of these fish were mortalities (James 2001). Entrainment has not been well documented at the other dams in the basin and additional studies are needed to quantify additional impacts.

Water Temperature

The elevated temperatures of water released from reservoirs in the basin may impact bull trout and other species (USBR 2000). Elevated water temperatures in some years have delayed the onset of spring chinook spawning in the upper Yakima River. Water temperatures which could delay spring chinook spawning, above 13 to 15 degrees Celsius (55 to 59 degrees Fahrenheit), would probably negatively impact bull trout given their need for cold water habitat (Rieman and McIntyre 1993). The historic thermal regimes below the natural lakes in the basin are unknown, but altered temperature regimes below dams is common (Ward 1985). Limnological studies conducted by the U.S. Bureau of Reclamation have shown temperature stratification to some degree in all of the storage reservoirs in the basin (USBR 2000). With the exception of Tieton Dam, the outlet works for each dam is located above the coldest waters available in the

reservoir pool. Studies to assess the limnological attributes of each storage reservoir should continue, and corrective actions for reducing water temperature releases from storage reservoirs to benefit bull trout should be implemented.

Reservoir Passage

Adult passage for adfluvial bull trout migrating from the storage reservoirs into their spawning streams can be a problems in years with below average snow pack and resulting low stream flows (USBR 2000). In drought years, it is not uncommon for most of the reservoirs in the Yakima basin to fall short of full storage capacity. At full capacity tributaries are inundated, as water from the reservoirs is released to meet irrigation demands, the lower reaches of the tributaries are exposed and flow for considerable distances across the reservoir bed. These seasonal channels change year-to-year and consist of unconsolidated reservoir sediments. While passage problems in any given year may be anticipated, it is difficult to predict their severity.

Box Canyon Creek, the primary spawning tributary to Lake Kachess, has experienced chronic passage problems. As an interim solution, the U.S. Bureau of Reclamation attempted to remedy the problem by channelizing the stream below the ordinary high water mark (NPPC 2001). However, this has proven ineffective as a permanent solution, and in 2001 (a drought year) only 7 to 8 bull trout were observed in the creek as late as September 18 (Thomas, J. U.S. Fish and Wildlife Service, *pers. comm.* 2002). At low flow, discharge in Box Canyon Creek was approximately 0.3 to 0.4 cubic meters per-second (12 to 14 cubic feet per-second). However, at the confluence with Lake Kachess the stream was effectively dry due to water percolating into the lake bed, resulting in a complete passage barrier. A similar condition has been observed on Indian Creek, a tributary of Rimrock Lake. Though not identified as a chronic problem, adult passage was precluded in 2001, at the site of the extensive alluvial fan which had formed at the mouth of the creek. The channel flowing across this fan was extensively braided with little flow in any single channel and relatively few adult fish had made it into Indian Creek by mid-September. Long-term solutions to reservoir passage problems need to be investigated and implemented.

Basin Flow Regimes

The operation of the dams in the Yakima Core Area has had a profound effect on the flow regimes of the rivers in the basin and has reduced habitat quality within the basin and can result in salmonid mortality (Snyder and Stanford 2001; NPPC 2001). Below storage reservoirs, habitat degradation associated with non-normative flows have likely impacted bull trout. The magnitude of high flows resulting from rain-on-snow events and during the snowmelt runoff period has been reduced significantly (Figures 3 through 5); the hydrograph for the upper Yakima River is extremely unnatural in the opposite direction during July and August (Figures 3 through 4). But it is the late summer/early fall hydrology in the upper portion of the basin that is most problematic for bull trout. This is due primarily to an operational procedure known as "flip-flop." Pursuant to a 1980 decision of the Federal District Court for the Eastern District of Washington, the Yakima Project is operated to protect incubating spring chinook salmon eggs and alevins in the upper Yakima River basin. The Yakima, Cle Elum, and Tieton rivers are operated as a conduit to deliver irrigation water from April through mid-October. Through early September, most irrigation water is released from the reservoirs on the Yakima River side of the basin (Keechelus, Kachess, and Cle Elum dams) with only minimal releases from the reservoirs on the Naches River side (Rimrock and Bumping).

Figure 3. Hydrograph for the Yakima River at the Cle Elum gaging station (River Mile 183) for the period 1981 through 1999.

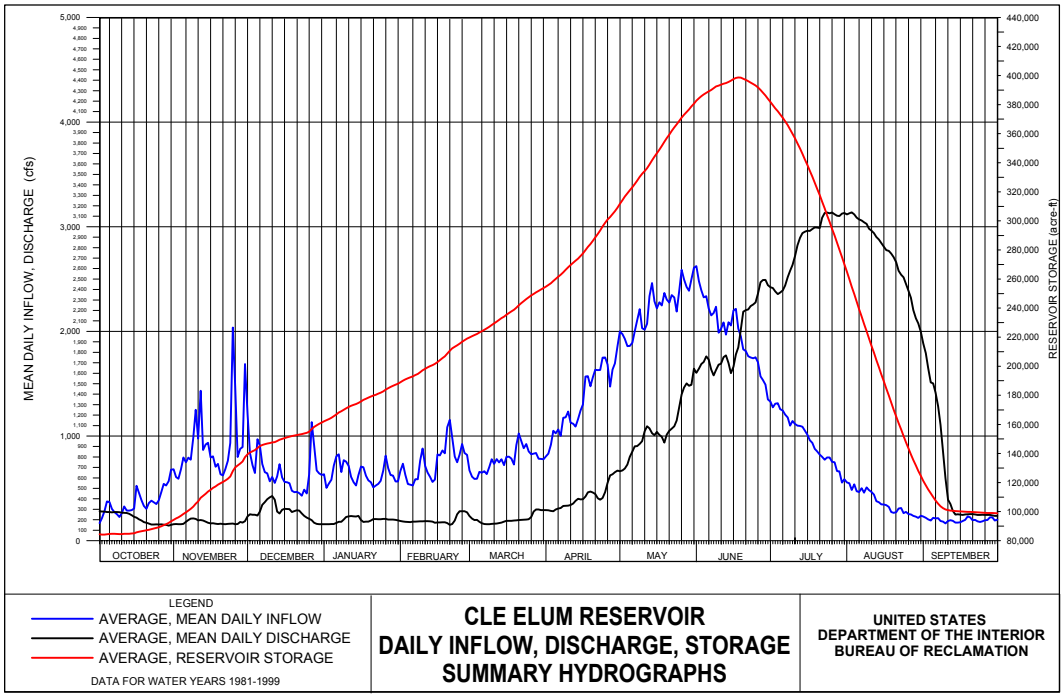


Figure 4. Hydrograph for the Yakima River at the Umtanum gaging station (River Mile 140.5) for the period 1981 through 1999 .

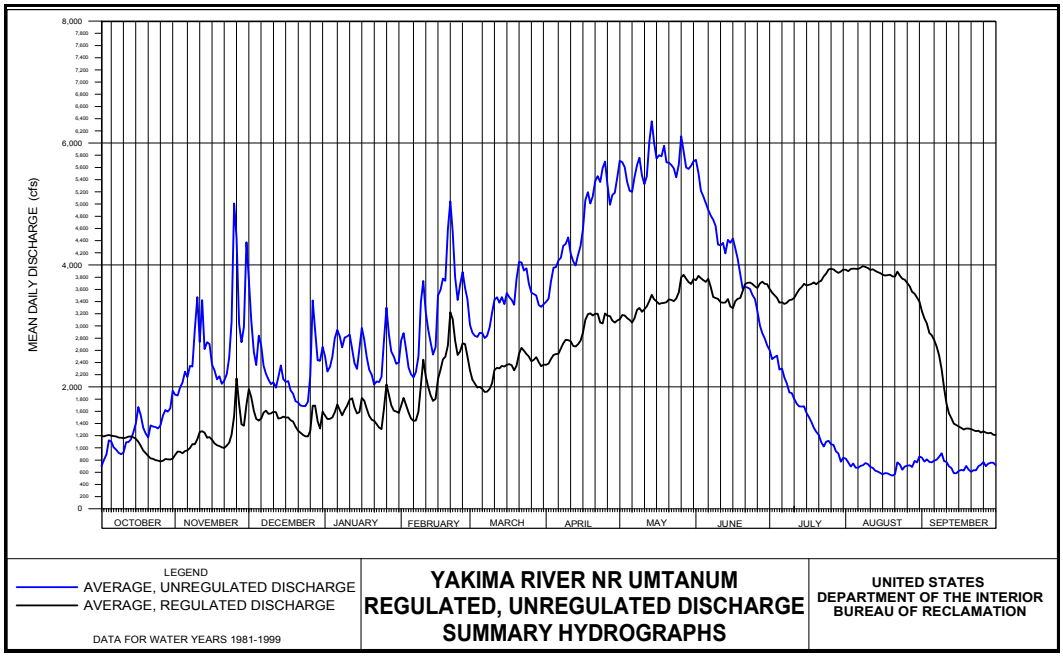


Figure 5. Yakima River at the Parker gaging station (River Mile 104) for the period 1981 through 1999.

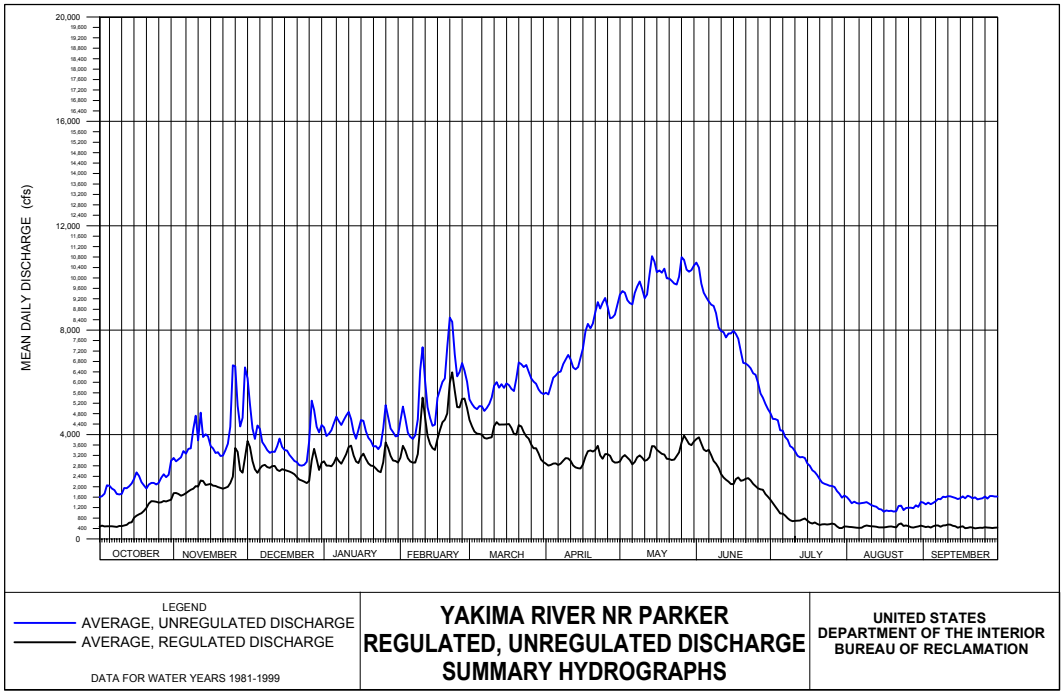


Figure 6. Hydrograph for the Naches River near Naches, Washington for the period 1981 through 1999.

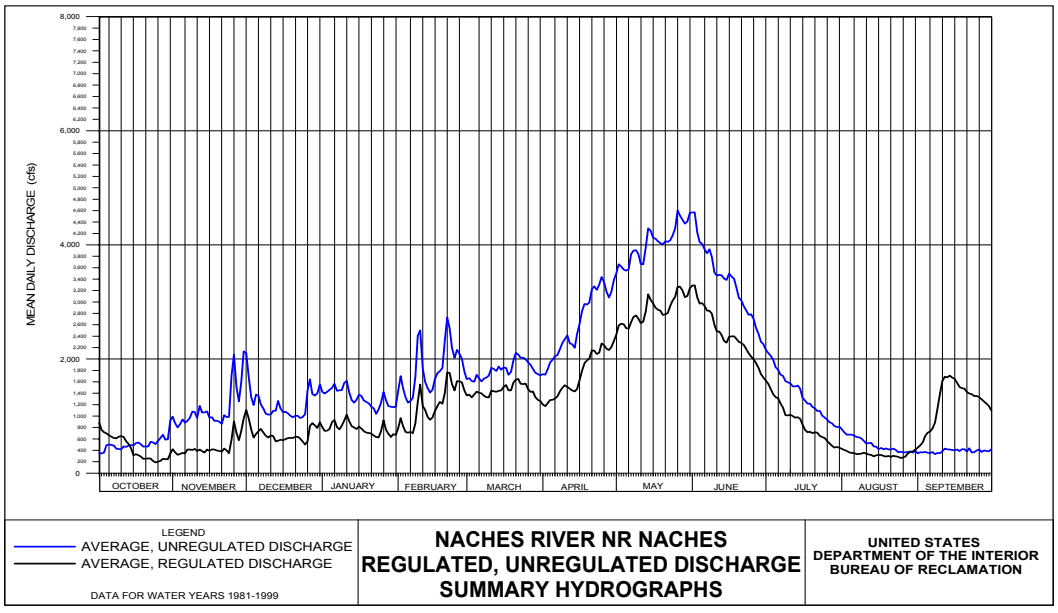


Figure 7. Hydrograph for the Cle Elum River in the upper Yakima Basin (represented by the discharge plot on the graph) for the period 1981 through 1999.

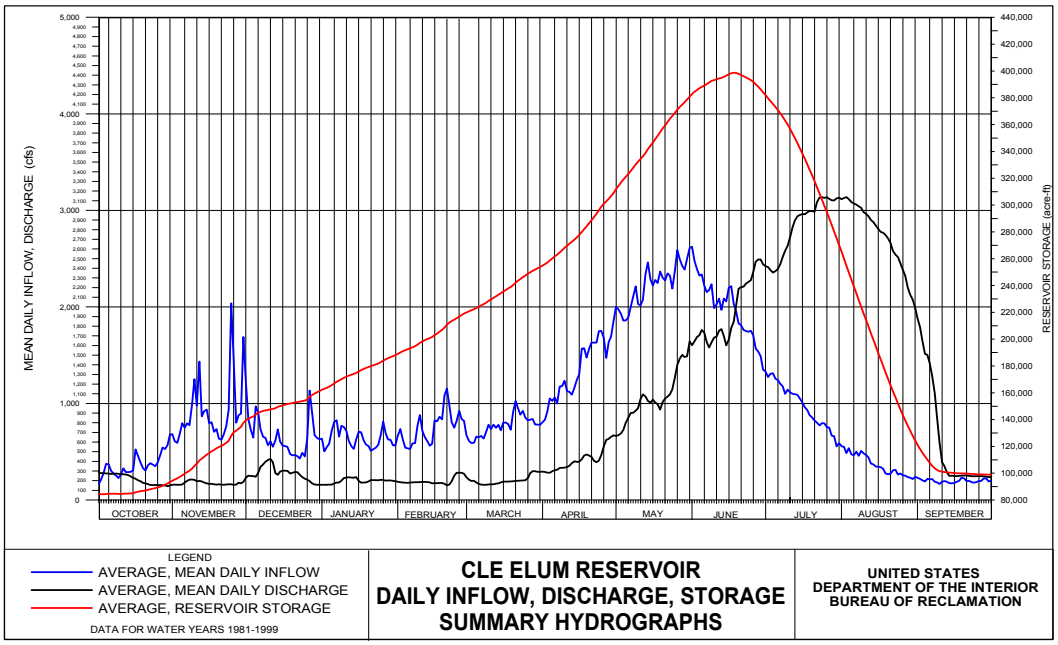
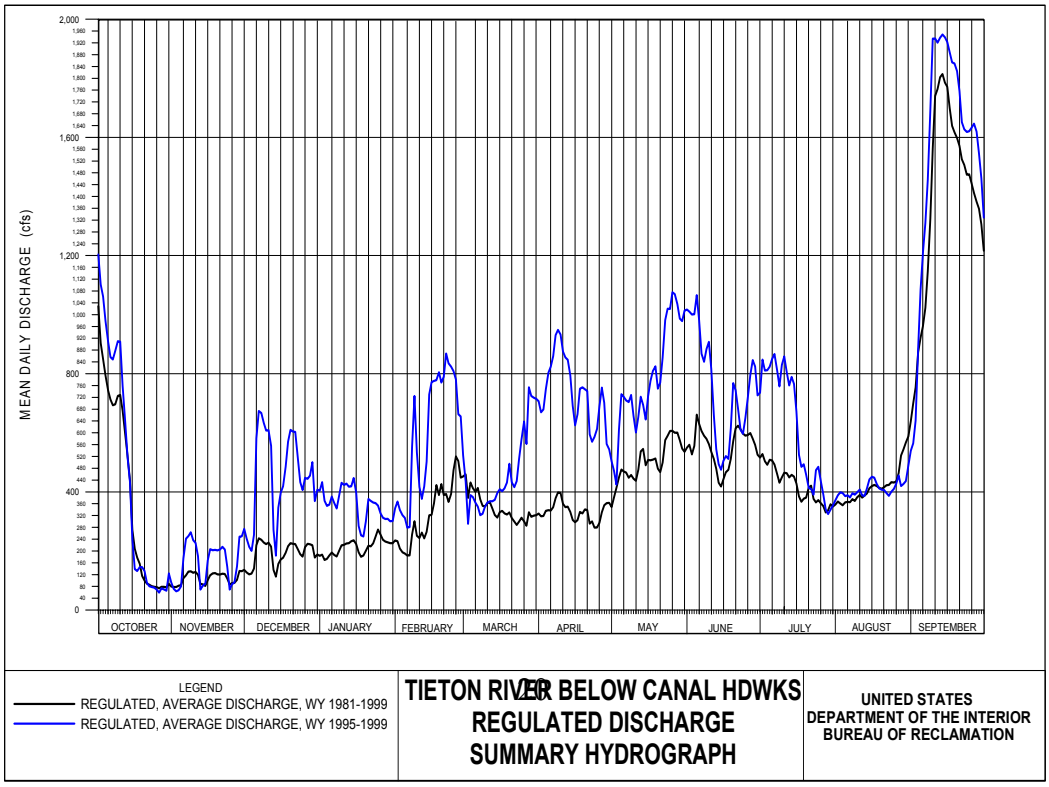


Figure 8. Hydrograph for the Tieton River below the Yakima- Tieton Irrigation Districts headworks for the period 1981 through 1999. Only regulated streamflow data are available for this site.



On, or near September 10, this release pattern is switched and late season irrigation demands are met from the Naches River side for approximately 90 days. The effect of this operational schedule is complete inversion of the flow regimes on both sides of the basin (Figures 3 and 6). The abnormally high flows in the upper Yakima River are reduced to levels very close to those which would occur in an unregulated river (Figure 3). On the Cle Elum River, where high flows released from the largest reservoir are maintained the entire summer, the effect is more profound, as flows drop an order of magnitude in the fall (Figure 7).

In the Tieton River the effect is the opposite as flows increase four to five times over the level at which they were held most of the summer (Figure 8). The narrowly confined Tieton River channel conveys exceedingly high flows for most of its course. At the end of the irrigation season the Yakima Project implements storage control measures, and flows in the Tieton River are often reduced below 0.6 cubic meters per second (20 cubic feet per second). Flows are usually reduced on the Yakima River side of the basin as well, sometimes by as much as 50 percent, but they are required to protect spring chinook redds. On either side of the basin these unstable and abnormal flow patterns have likely had a negative impact on fluvial bull trout. Successful spawning under these conditions would be unlikely in the upper Yakima, Cle Elum and Tieton Rivers. Habitat stability for other life history forms of the species and for other taxa in the aquatic community may be also seriously compromised under current operating conditions.

Summary

The development of irrigation storage reservoirs and diversion dams and their current operation has significantly altered habitat conditions within the Yakima Core Area. Fragmentation of habitat associated with the construction of Kachess, Keechelus, Cle Elum, Bumping, and Rimrock reservoirs limits migration in the core area. Construction of these facilities without passage has isolated local populations and contributed to the decline of bull trout within the basin. The Middle Columbia Recovery Unit Team recommends isolated local populations within the core area be reconnected. Entrainment in the outlet works

at each facility is a concern and further studies are needed to quantify the level of impact and recommend corrective actions. In addition, the Bureau of Reclamation should manage reservoir levels to ensure safe passage for adfluvial bull and provide lower water temperature releases to improve bull trout habitat. Finally, normalization of the flow regimes below each project is important for recovery of bull trout.

Forest Management Practices

Both direct and indirect impacts from timber harvest have altered habitat conditions in portions of the Middle Columbia Recovery Unit (Dawson 1999; MacDonald 1999; MacDonald and Mayo 1999). Impacts from timber harvest management can include the removal of large woody debris, reduction in riparian vegetation, which results in water temperature increases, accelerated erosion, and de-stabilization of stream channels. Today the legacy of these activities still persists where the road conditions, channel changes, and compaction of hill slopes remain.

The aquatic assessment portion of the Interior Columbia Basin Ecosystem Management Project provided a detailed analysis of the relationship between road densities and bull trout status and distribution (Quigley and Arbelbide 1997). The assessment found that bull trout are less likely to use streams for spawning and rearing in highly roaded areas, and were typically absent at mean road densities above 1.1 kilometer per square kilometer (1.7 miles per square mile). Road construction and maintenance can lead to effects to bull trout habitat when sedimentation, channel connectivity, high erosion and slope hazards, culvert sizes, and access are not addressed concurrently with land management proposals. Roads can promote simplification and channelization, which reduces the connectivity of surface and ground waters.

In addition to specific restoration activities, the Middle Columbia Recovery Unit Team recommends monitoring of current Federal and State guidelines for forest management practices to ensure the health of watersheds which contain bull trout. Bull trout watersheds should be adaptively managed

and regulations should be modified if current standards are found to provide inadequate protection. Moreover, specific habitat guidelines (*e.g.*, sediment delivery, water temperature, normative hydrologic function) for bull trout habitat should be developed. Roads and associated culverts, which contribute to the degradation of bull trout habitat should be identified and corrective measures implemented. The following summarizes watersheds within the Middle Columbia Recovery Unit where forest management has contributed to degraded habitat conditions.

Upper Yakima River

The Upper Yakima River watershed has an extensive history of forest management. Twenty-six percent of the watershed is an early seral (seedling/sapling) stage primarily from timber harvest (MacDonald and Mayo 1999). The watershed is heavily roaded for timber harvest purposes with a road density of 2.6 kilometers per square kilometer (4.1 miles per square mile) (U.S. Forest Service (USFS) *in litt*. 1998). One example is Lower Cabin Creek where the channel is widening and subsequent bedload deposition has increased, this is an due to increased peak flows from roads and logging in the subwatershed. A number of streams are on the 303(d) list for exceeding temperature levels including Big Creek and Cabin Creeks. According to the U.S. Forest Service, logging and roads in riparian habitat may be contributing to high summer stream temperatures (MacDonald and Mayo 1999). Fine sediment in spawning habitat areas exceeds 15 percent by volume in Cole, Gold, Little and Big creeks (MacDonald and Mayo 1999**)**.

Cle Elum River

Timber harvest in the Cle Elum watershed began in 1909. Harvest centering around Cle Elum Lake began in the 1950's and continued through the 1980's. By the 1990's harvest had dramatically decreased due to the listing of the spotted owl and the adoption of the Northwest Forest Plan in 1994 **(**Macdonald and Mayo 1999**)**. Road densities around Cle Elum Lake, Lower Cle Elum River, and Middle Cle Elum River range from 1.6 to 2.4 kilometers per square kilometer

(2 to 3.8 miles per square mile) (USFS *in litt*.1998). Past activities in these disturbed watersheds may be contributing to a lack of pools in the Cle Elum River, eroding banks, accelerated bedload deposition, and unstable bars. The low density of large woody debris, and potential for recruitment, in the Cle Elum drainage are also considered a problem by the U.S. Forest Service and is likely related to past timber management programs (MacDonald and Mayo 1999).

Taneum River

Logging began in the Taneum River watershed in the 1930's with the construction of a railroad up Taneum Creek. Selective harvest was the primary silviculture prescription until the late 1960's when clearcutting became a more common practice in the watershed. Timber harvest and associated development have impacted between 20 and 30 percent of the watershed (U.S. Department of Agriculture (USDA) 1995). The Taneum River watershed is heavily roaded, having a road density of 2.4 kilometers per square kilometer (3.9 miles per square mile), the North Fork Taneum River watershed has a road density of 1.6 kilometers per square kilometer (2.6 miles per square mile), and the South Fork Taneum River watershed has a road density of 0.7 kilometers per square kilometer (1.2 miles per square mile) (USFS *in litt.* 1998).

Ahtanum Creek

Timber harvest along streams has reduced large woody debris recruitment, canopy cover, and bank stability and some road segments are contributing fine sediment into streams (Washington Department of Natural Resources (WDNR) 1998). Areas of concern include North Fork Ahtanum Road, Shellneck Road, and Upper South Fork Ahtanum Road. Road density estimates for the Ahtanum Creek drainage are not currently available. A limiting factor analysis associated with forest management practices in Ahtanum Creek and associated impacts to bull trout is needed.

Teanaway River

Past forest management activities in the Teanaway River have caused bank and channel erosion, reduced large woody debris and canopy cover (MacDonald and Mayo 1999). Many segments of the road system contribute fine sediment to the stream system. Specific areas of concern include: 1) U.S. Forest Service roads 9738 and 9701, 2) Indian Creek Road, 3) Middle Creek Road, 4) Dickey Creek Road, 5) Lick Creek Road, 6) Carlson Creek Road, 7) Dingbat Creek Road, 8) and Sandstone Creek Road. Logging activity on private land continues in the middle portion of the basin, and associated impacts to bull trout need to be evaluated and addressed.

Naches River

Past forest practices, including road construction, has likely contributed to degraded habitat in the Little Naches River watershed (Dawson 1999). The Little Naches River, Crow Creek, and Bear Creek are on the 303(d) list for exceeding temperature limits. Fine sediment in spawning gravel has been annually sampled in the watershed since 1991. Elevated fine sediment levels in sampled tributaries have ranged between 12 and 20 percent above baseline conditions. In 1992, a road inventory covering 346 kilometers (215 miles) indicated that over 50 percent of the roads surveyed in the watershed had the potential for elevated sediment delivery to streams. Of these streams, 20 percent showed evidence of actively delivering fine sediment. Specific areas of concern include U.S. Forest Service roads 1900, 1501, and 620 in the Little Naches River and Rattlesnake Creek drainages. Recent efforts to improve roads and decrease sediment input are helping the problem and should be continued.

Tieton River

Timber management has likely impacted tributaries to the Lower Tieton River such as Wildcat, Milk and Oak creek drainages (MacDonald *et al*. 1998a). Timber harvest has occurred within riparian reserves along a few tributary streams such as Short and Dirty creek, Pinegrass, Grey and Cold creeks. There

has been some recent timber harvest within riparian reserves including approximately 4 miles in the headwaters of the South Fork Tieton River and approximately 2 miles in the lower South Fork Tieton River (MacDonald *et al.* 1998b). There are no quantitative fine sediment data for the Upper Tieton River and monitoring programs should be initiated. The extent to which timber harvest has contributed to additional sediment is not known, and studies are needed to quantify the impact and identify potential problem areas.

Livestock Grazing

Improperly managed livestock grazing can degrade bull trout habitat by removing riparian vegetation, which destabilizes streambanks, widens stream channels, promotes incised channels, lowers water tables, reduces pool frequency, increases soil erosion, and alters water quality (Howell and Buchanan 1992; Mullan *et al.* 1992; Overton *et al.* 1993). These effects can reduce overhead cover, increase summer water temperatures, and increase sediment in spawning and rearing habitats.

Watersheds within the recovery unit have a long history of cattle and sheep grazing dating back to the 1800's (NPPC 2001). Overall, the Middle Columbia Recovery Unit Team recommends the development and implementation of adaptive livestock grazing management plans, which include performance standards and targets that grazing practices must meet and will ensure adequate habitat and water quality conditions for bull trout recovery. Plans should address grazing exculaion areas in sensitive bull trout areas (*e.g.*, spawning grounds in August and September). Areas of concern within the Yakima Core Area include Ahtanum Creek, Teanaway River, and the Tieton River.

Ahtanum Creek

Cattle grazing has caused eroding stream banks and accelerated fine sediment delivery to Ahtanum Creek. Cattle trampling bull trout redds is another concern in this watershed (Anderson, E. *in litt*. 2001b)**.** A limiting factors analysis directed at gaging the impacts of grazing within the basin is needed.

Teanaway River

Some areas in the Teanaway River have had substantial effects from cattle grazing (Mayo and MacDonald 1999). Eroding banks and accelerated fine sediment delivery have been observed along several tributaries to the North Fork Teanaway River including Jungle, Jack, Indian, Middle, Dickey and Lick creeks. Much of the mainstem of the North Fork Teanaway River also has effects from grazing, which may be limiting the establishment of riparian vegetation along some stream reaches and contributing to elevated stream temperatures.

Tieton River

Impacts to aquatic habitat from grazing within the lower Tieton River is a concern in the Oak Creek drainage (off the U.S. Forest Service lands), Soup Creek, upper Wildcat Creek and Milk Creek (MacDonald *et al.* 1998a). Vegetation in the Soup Creek drainage has been altered by a long history of ungulate grazing, both cattle and elk. Range conditions have improved over the last 30 to 40 years from a very poor to only fair, at best (MacDonald *et al.* 1998a).

Grazing is also a concern in the Upper Tieton watershed (MacDonald *et al.* 1998b). Of particular concern, is over utilization of Minnie Meadows and Conrad Meadows adjacent to the South Fork Tieton. Total utilization of meadow forage is 73 percent (57 percent by elk and 16 percent by cattle). Minnie Meadows has been fenced but cattle were still able to get into the meadow in 1999. Further action is proceeding to continue to keep cattle away from the meadow and South Fork Tieton River.

Agricultural Practices

With over 202,500 hectares (500,000 acres) of irrigated land, the Yakima River basin ranks fifth nationally in total agricultural production (USBR 1999). Bull trout habitat within the Yakima basin has been adversely affected by irrigation diversions and water withdrawals (Snyder and Stanford 2001). Water withdrawals from streams by 64 irrigation diversions within the basin contribute to low flow conditions in some streams, and seasonal dewatering of others. Seven mainstem irrigation diversion dams (Easton, Town Ditch, Wapato, Sunnyside, Prosser, and Horn Rapids) have contributed to altered flow regime within the basin (Snyder and Stanford 2001). Low flows can inhibit bull trout spawning migrations and result in the stranding of juvenile bull trout (Anderson, E., Washington Department of Fish and Wildlife Service, *pers. comm.* 2002a). The Middle Columbia Recovery Unit Team recommends that impacts of irrigation withdrawal on bull trout passage within the Yakima Core Area be evaluated and appropriate instream flows instituted. Specific areas of concern include: Lower Rattlesnake Creek; Big Creek; Lower Taneum Creek; Teanaway River; Gold Creek (Keechelus Lake); and Ahtanum Creek below River kilometer 32 (River Mile 19.7).

Unscreened or inadequately screened irrigation diversions can strand bull trout in irrigation canals. To limit the possibility for entrainment and mortality, all water diversions and irrigation ditches in the Yakima Core Area need to be adequately screened. Specific areas of concern include: lower North Fork Ahtanum Creek and in the mainstem Ahtanum Creek between John-Cox Ditch and the upper Wapato Irrigation Project Diversion; and the Teanaway River to reduce stranding in irrigation canals. (*i.e.*, Coleman and Wilson creek drainages). In addition, existing screened diversions should be evaluated to ensure proper operation and full compliance with existing standards.

Water quality problems associated agricultural withdrawal can include elevated water temperature, increased sediment delivery from return flows, and higher levels of pollution from agricultural chemicals (Snyder and Stanford 2001). Specific bull trout watersheds that are at risk from water quality problems

include the Teanaway River, Taneum Creek, Naches River, Tieton River, and Ahtanum Creek.

Portions of the mainstem Yakima River do not comply with Washington State Department of Ecology standards for temperature, fecal coliform, sediment, and pesticide residue, and have been placed on the Section 303(d) list of the Clean Water Act (NPPC 2001; Washington Department of Ecology (WDOE) 1997). Turbidity and phosphorus have also been detected at concentrations that may affect aquatic life. There is a fish consumption advisory for resident fish taken from the Yakima River from its mouth to just above Yakima and some lower river tributaries, due to high herbicide levels in resident fish tissue samples (Johnson *et al*. 1986). The National Water Quality Assessment Program conducted a pilot study in 1990, which indicated that fish, benthic invertebrate, and algal communities in the lower Yakima River and some tributaries were compromised, and concluded the ecological health in these stream reaches was impaired (NPPC. 2001). While specific impacts to bull trout are unknown, impaired water quality in Yakima River limits the habitat quality in the mainstem and could effect use by subadult, and adult bull trout. The Middle Columbia Recovery Team supports ongoing efforts directed at reducing point and nonpoint source pollution and improving water quality in the mainstem Yakima River (See Ongoing Conservation Measures). These efforts should continue to be funded and results monitored and evaluated.

Mining

Mining can degrade aquatic habitats used by bull trout by altering; water chemistry (*e.g.*, pH), stream morphology and flow; and causing sediment, fuel, and heavy metals to enter streams (Martin and Platts 1981; Spence *et al.* 1996; Harvey *et al.* 1995). There is a limited amount of small-scale suction dredging and hard rock mining still occurring in several watersheds including the Little Naches, and Cle Elum (Dawson 1999; MacDonald 1999). In these areas, mining runoff should be reduced by removing and/or stabilizing mine tailings. The Middle Columbia Recovery Unit Team recommends that all mining activities

should be conducted so as to minimize impacts to bull trout and their habitat and must comply with the Washington State Hydraulic Code (WDFW 1999).

Specific recommendations for mining activities include: no mining be conducted during spawning, egg incubation, or prior to fry emergence; mining activities should only be conducted within the ordinary high water mark of the stream; mining activities should not disturb stream channel banks or riparian vegetation; depressions created by mining activities must be refilled immediately after operations are completed; suction hoses shall be adequately sized and screened to prevent juvenile fish from being injured; mining equipment will be inspected and maintained in a manner that prevents leaking of fuels and contaminants from entering waters; all fuels and other contaminants will be stored away from the stream and in a manner that will prevent entry into waters; and monitoring will be conducted to determine the effectiveness of regulations and recovery actions to provide desired habitat and water quality conditions.

Residential Development and Urbanization

Specific areas within the Yakima River basin have grown in popularity as a preferred area for home sites. As the population increases more impacts to riparian areas and water quality are likely (NPPC 2001). Future impacts may include increases in nutrient loading from septic systems, chemical applications, alterations to channel morphology, and effects from road construction. Increased compliance monitoring is needed to assess the effects of this development and determine if State, county and Tribal management plans are being followed. Areas of particular concern for floodplain development are Lower Little Creek and the Naches River (Anderson, E. *pers. comm.* 2001a).

Fisheries Management

Harvest and Hatcheries

Relatively little is known about the harvest impacts on bull trout in the Yakima River basin. Existing angler catch records, some of which date back to the 1930's show few bull trout harvested relative to other species. Due to the

random and nonstandardized fashion most catch information was collected it is useful only for showing the presence of bull trout in a particular stream and possibly their relative abundance compared to other species. Although bull trout were observed in creel checks, they were probably targeted by relatively few anglers, in part, due to their lower abundance and because they were not as highly regarded as other game fish (Anderson, E. *pers. comm.* 2002b).

Although angling impacts and harvest are not known, they may have been significant in some areas of the basin. Large fluvial and adfluvial bull trout were easily harvested from spawning areas prior to the implementation of restrictive fishing regulations in the mid-1980's, since they were easily observed, hooked, or snagged in the small clear water streams where they spawned (Anderson, E. *pers. comm.* 2002b).

It is likely that negative impacts to bull trout also resulted from stocking large numbers of catchable-sized hatchery rainbow into Yakima basin streams during the 1960's to early 1980's (*e.g.*, Ahtanum, Naches, Tieton/Rimrock and Teanaway drainages) (WDFW 1998). Impacts from stocked fish include competition for food and space, predation on bull trout juveniles, and increased harvest by anglers. Although most angler effort was directed at catching stocked trout, the incidental catch and harvest of bull trout likely occurred at a higher rate as well. The use of bait and barbed treble hooks by anglers fishing for other species (*e.g.*, rainbow, cutthroat trout) also increased the hooking mortality of incidentally caught and released bull trout (WDFW 1998). The combination of hatchery-stocked rainbow, large catch limits, the use of bait and easy public access to mainstem and tributary streams generated high angling pressure that probably had negative impacts on the wild bull trout stock.

In addition to general harvest impacts in the Yakima basin, poaching has been identified as a serious concern in Gold Creek (Keechelus Lake tributary), Box Canyon Creek (Kachess Lake tributary), Deep Creek (Bumping Lake tributary), South Fork Tieton River and Indian Creek (Rimrock Lake tributaries) (WDFW 1998; Anderson, E. *pers. comm.* 2002b). It is not known how much of a problem poaching may be for other Yakima basin bull trout populations. The

combination of easy public access to the spawning grounds and the early migration of adult spawners into the streams during the high summer recreational-use period compounds the problem. Since misidentification of bull trout by recreational anglers is a problem in other recovery units (Schmetterling and Long 1999), it may also be a problem in the Yakima River basin and an education program should be developed to limit incidental mortality.

Nonnative Species

A wide range of non-native species have been introduced into the Yakima basin including brook trout, lake trout, brown trout, bass, catfish, bluegill, sunfish, and crappie (Snyder and Stanford 2001). Warm water species such as, bass and catfish were originally introduced into the lower Yakima River in the early 1900's. Cold water salmonid species (*e.g.*, brook and lake trout) were introduced into the upper basin in the mid-1900's. Although nonnative species are no longer stocked in the main stem river areas where there is the potential to interact with native species they have become established in many areas of the basin with self-sustaining, naturally reproducing populations. Probable impacts to bull trout include predation on juveniles and competition for food and space.

Brook trout may also pose a serious genetic threat to bull trout due to the potential for hybridization (WDW 1992; Rieman and McIntyre 1993). Since the resulting offspring are fertile it provides an avenue for further introgression with bull trout populations. Currently, there are naturally reproducing populations of brook trout throughout the upper Yakima and Naches river basin (WDFW 1998). Notable brook trout concentrations exist in the Cle Elum and Waptus Lake drainages, the upper Yakima River between Easton and Keechelus lakes, and small tributary streams of the Naches (*e.g.*, Milk Creek) and upper Yakima (*e.g.*, Taneum Creek) Rivers.

Other nonnative species introduced into the basin include brown trout and lake trout (WDFW 1998; Snyder and Stanford 2001). Brown trout were found in Cooper Lake (upper Cle Elum River) in 1987, most likely the result of an unauthorized introduction. Surveys conducted in 1995, confirmed the presence of

a wide range of sizes of brown trout, suggesting that natural reproduction is occurring. In 1996, brown trout were also discovered in the lower Waptus River.

Lake trout were probably stocked into Cle Elum, Kachess, and Keechelus lakes before 1933 (WDFW 1993). Lake trout are thought to be reproducing in Cle Elum Lake. While abundance of lake trout in this lake is thought to be low, no directed studies to verify their current status have been conducted. Introductions into Kachess and Keechelus lakes are thought to have been unsuccessful, however, there are no data to confirm the present status in either lake (WDFW 1998). The potential for competition and predation on bull trout should be investigated, and if warranted, actions to reduce the impact implemented.

ONGOING RECOVERY UNIT CONSERVATION MEASURES

A multitude of habitat restoration and fishery reintroduction efforts have been conducted within the Yakima River basin (NPPC 2001). In addition, a variety of projects and planning activities attempting to address limiting factors within the basin are currently under development. Cooperative agreements between State, local, Tribal, and private entities are numerous (NPPC 2001). The majority of the fishery related activities focus on the restoration of salmon and steelhead within the basin, and the direct, or indirect benefit to bull trout needs further investigation. A compilation of these activities can be found in the 2001 Draft Yakima Subbasin Summary (NPPC 2001). Specific conservation measures identified by the Middle Columbia Recovery Unit Team that are currently being implemented, and will benefit bull trout, are discussed in this section.

Federal Lands and Activities

To reduce the impacts from roads in the Little Naches watershed, 16 miles of road have been obliterated in the past 4 years **(**Dawson 1999**)**. Between road improvements that Plum Creek Timber Company and the U.S. Forest Service have done in the watershed, approximately half of all the road problem areas have been taken care of through surfacing roads, installing ditch relief pipes, and stabilizing cut slopes (Dawson1999).

In 1996, the U.S. Forest Service closed access and camping to all of the dispersed sites adjacent to Box Canyon Creek below the first waterfall in an effort to restore instream habitat, riparian vegetation and reduce poaching opportunities. At the same time, dispersed sites above the waterfall were altered and a user-built access road across the floodplain was closed in an effort to restore floodplain function, riparian vegetation and protect instream habitat. In addition, drainage improvements on the Box Canyon road network to reduce delivery of sediment to streams was conducted. In the area of the Cle Elum River between the reservoir and Salmon La Sac, the U.S. Forest Service started a project in the summer of 1997 to modify dispersed camping sites and close user-built roads in an effort to rehabilitate the riparian reserves and in-channel habitat.

The Northwest Forest Plan has greatly reduced logging and road construction on U.S. Forest Service lands. Recreational vehicle trails and dispersed camping problems on National Forest lands are being improved through trail upgrading or reconstruction, road obliteration, dispersed site restoration and public education. These activities are most prevalent in the Cle Elum and Swauk watersheds with work also occurring in the Taneum Creek, Manastash Creek, and North Fork Teanaway. Sheep grazing practices have been modified so that grazing impacts to riparian and stream habitats are now minimal on U.S. Forest Service lands within the Swauk watershed. The U.S. Forest Service and Plum Creek Timber Company have completed a land exchange. The exchange was recently finalized and has transferred several sections of land in the upper Yakima River watershed to the U.S. Forest Service lands.

Until recently, the irrigation diversion at Selah on the Naches River contributed to high fish mortality rates. Funds made available through the Northwest Power Planning Council's Fish and Wildlife Program, were used to replace old screens at this diversion. Recent improvements in screen design and more stringent screening requirements have assisted in reducing fish stranding and passage problems.

Water Quality

Recently, State, Federal, and Tribal agencies, irrigation entities, and individuals in the Yakima River basin have initiated programs and projects to begin correcting some of the water quality problems. Water conservation projects are intended to be a primary means of improving water quality. Some of the irrigation districts have implemented water quality monitoring programs and policies with the goal of meeting State water quality standards for irrigation return flows.

Fisheries Management

Due to concerns over hybridization with bull trout, brook trout are no longer stocked in bull trout watersheds. Fishing regulations for brook trout were also liberalized in stream environments. Anglers may retain up to five brook trout but only two of other trout species (excluding bull trout). Although other nonnative species are not stocked directly into stream environments, fisheries managers are continuing to screen lake or pond outlets where nonnative warm water species (such as bass and catfish) are being actively managed. Catchable-sized hatchery rainbow trout stocking was eliminated in the mainstem Yakima River and in the Ahtanum Creek drainage by the early 1980's and in most other Yakima basin tributaries in the early 1990's to avoid potential negative interactions with native fish species (including bull trout).

Restrictive fishing regulations for bull trout began in 1984 with a one-fish catch limit and a 20-inch minimum size limit for fish caught in lakes and 6 inches for fish caught in tributary streams. In 1986, the minimum length was increased to 8 inches in streams, and fishing for bull trout was closed from August 15 to September 30 to protect spawning fish. In 1987, fishing for bull trout was prohibited in Kachess and Keechelus lakes. In 1992, fishing for bull trout was prohibited in the entire Yakima River drainage.

Since 1990, the use of bait and barbed treble hooks has been prohibited in the upper Yakima River (from Roza Dam to Keechelus Dam) and in Rattlesnake Creek (Naches drainage) to reduce the mortality rate of released trout and salmon (including bull trout). It also became illegal to harvest fish in these areas; catch-and-release regulations were adopted. In 1998, the use of bait and barbed treble hooks was prohibited in other upper Yakima River tributaries including the Rainier Fork of the American River, Ahtanum Creek (mainstem, North and Middle forks), Bumping River (below the dam), Cle Elum River (below the dam), Cowiche Creek, DeRoux Creek, Kachess River, Naches River, Little Naches River, Taneum Creek, Swauk Creek, Taneum Creek, Teanaway River (mainstem and North Fork) and Ahtanum Creek.

In addition, there have been total fishing season closures on sections of Box Canyon Creek, Gold Creek, Indian Creek, Kachess River and Mineral Creek since 1990, and on the South Fork Tieton River and Deep Creek since 1995, to protect spawning and early-rearing bull trout. Additional fishing season closures were adopted in 1998 for sections of Bear Creek (a tributary of the South Fork Tieton River), North Fork Ahtanum Creek, Shellneck Creek, and Union Creek. These closures of bull trout spawning areas in conjunction with the posting of public information signs and increased enforcement patrols are designed to reduce the incidence of poaching.

Currently, the Washington Department of Fish and Wildlife is working with the Yakama Nation to supplement wild spring chinook and to reestablish self-sustaining populations of coho in the Yakima River subbasin. A hatchery facility was constructed at Cle Elum with several acclimation ponds in the upper basin. It is generally felt that this supplementation program will not impact bull trout stocks and will likely benefit bull trout and other resident fish. Historically, bull trout probably benefitted from the presence of anadromous salmonids from downstream drift of eggs released from spawning salmon that provided food for bull trout and other resident fishes, and more importantly, the presence of decaying salmon carcasses benefit fish and their habitat from nutrients.

Generally, in drainages colonized by native anadromous salmon and steelhead populations are where bull trout have successfully coexisted. However, in many areas where bull trout currently exist, habitat conditions have deteriorated and natural predator-prey balances have been upset. Bull trout populations are at or near critically low levels in many areas of the basin. For this reason, caution must be exercised in stocking large numbers of hatchery fish near bull trout spawning and rearing areas to avoid the potential for competition or predation on bull trout fry.

RELATIONSHIP TO OTHER CONSERVATION EFFORTS

Subbasin Planning

As part of the Pacific Northwest Electric Power Planning and Conservation Act of 1980, the Bonneville Power Administration has the responsibility to protect, mitigate and enhance fish and wildlife resources affected by operation of Federal hydroelectric projects in the Columbia River and its tributaries. The Northwest Power Planning Council develops and implements the Columbia River Basin Fish and Wildlife Program which is implemented by the Bonneville Power Administration, U.S. Army Corps of Engineers, and the Federal Energy Regulatory Commission. Coordination of Bonneville Power Administration's responsibilities for protection, enhancement, mitigation, and incorporation of recommendations by Northwest Power Planning Council is, in part, done through the development of subbasin summaries which identify status of fish and wildlife resources, limiting factors, and recommended actions.

The draft Yakima subbasin summary (NPPC 2001), overlaps in part with the Middle Columbia Recovery Unit, and is consistent with bull trout recovery planning efforts to identify limiting factors. The draft Yakima subbasin summary identifies degraded habitat and water quality conditions, loss of connectivity due to dams and irrigation withdrawal, introduction of nonnative species, and disruption of normal hydrologic processes as contributing to the decline of bull trout. The overall goal of the draft Yakima subbasin summary is, " to protect, restore and enhance fish and wildlife and their habitats in the Yakima subbasin to provide ecological, cultural, economic and recreational benefits." Identified objectives and strategies dealing with bull trout in the subbasin summary are in large part consistent with actions identified in the Middle Columbia Recovery Unit Chapter. The Middle Columbia Recovery Unit Team will continue to coordinate with these planning efforts through the development of subbasin plans.

Salmon Recovery Efforts

In March 1995, the National Marine Fisheries Service listed summer steelhead in the mid-Columbia Evolutionary Significant Unit as threatened under the Endangered Species Act. This Evolutionary Significant Unit encompasses the

Yakima River and tributaries and overlaps with the Middle Columbia Recovery Unit for bull trout. As part of the recovery planning process for chinook and steelhead the National Marine Fisheries Service issued guidance for the technical development of recovery plans (National Marine Fisheries Service (NMFS) *in litt.* 2001). The framework for steelhead and salmon recovery plan development is divided into distinct geographic areas, or domains which may contain multiple Evolutionarily Significant Units. Recovery plans for listed salmon and steelhead will contain the basic elements mandated by the Endangered Species Act, which include: 1) objective measurable criteria, 2) description of site-specific management actions necessary to achieve recovery, and 3) estimates of cost and time to carry out recovery actions. Time-frames for recovery plan development for the Middle Columbia River spring chinook and steelhead have not been finalized, but the Middle Columbia Recovery Unit Team will coordinate the implementation of bull trout recovery actions with salmon and steelhead measures to avoid duplication and maximize the use of available resources.

State of Washington

Salmon Recovery Act

The Governor's Office in Washington State has developed a Statewide strategy (Washington Governor's Salmon Recovery Office 1999) that describes how State agencies and local governments will work together to address habitat, harvest, hatcheries, and hydropower as they relate to recovery of listed species. The Salmon Recovery Act, passed in 1998, provides the structure for salmonid protection and recovery at the local level (counties, cities, and watershed groups).

This Salmon Recovery Planning Act directs the Washington State Conservation Commission, in consultation with local government and Treaty Tribes to invite private, Federal, State, tribal, and local government personnel with appropriate expertise to convene as a Technical Advisory Group. The purpose of the Technical Advisory Group is to identify habitat limiting factors for salmonids. Limiting factors are defined as, "conditions that limit the ability of habitat to fully sustain populations of salmon, including all species of the family Salmonidae." The bill further clarifies the definition by stating, "These factors

are primarily fish passage barriers and degraded estuarine areas, riparian corridors, stream channels, and wetlands." It is important to note that the responsibilities given to the Conservation Commission do not constitute a full limiting factors analysis. This report is based on a combination of existing watershed studies and knowledge of the Technical Advisory Group participants.

Washington State Bull Trout Management Plan

The Washington Department of Fish and Wildlife developed a bull trout management plan that addresses both bull trout and Dolly Varden (WDFW 2000). The Washington Department of Fish and Wildlife no longer stocks brook trout in streams or lakes connected to bull trout waters. Fishing regulations prohibit harvest of bull trout, except for a few areas where stocks are considered "healthy," within the State. The Washington Department of Fish and Wildlife is also currently involved in a mapping effort to update bull trout distribution data within the State of Washington, including all known occurrences, spawning and rearing areas, and potential habitats. The salmon and steelhead inventory and assessment program is currently updating their database to include the entire state, which consists of an inventory of stream reaches and associated habitat parameters important for the recovery of salmonid species and bull trout.

Forest Practices

In January 2000, the Washington Forest Practices Board adopted new emergency forest practice rules based on the Forest and Fish Report (Washington Forest Practices Board (WFPB) 2000). These rules attempt to address riparian areas, roads, steep slopes, and other elements of forest practices on non Federal lands. Although some provisions of forest practice rules represent improvements over previous regulations, the plan relies heavily on an adaptive management program to determine if the new rules will meet the conservation needs of bull trout. Research and monitoring is to be conducted to address areas of uncertainty for bull trout include protocols for detection of bull trout, habitat suitability, forestry effects on groundwater, field methods or models to identify areas influenced by groundwater, and forest practices effect on cold water temperatures. The Forest and Fish Report developed through negotiations between stakeholder groups including State agencies, counties, Federal agencies, some Tribes, and the

forest industry. A similar process is also being used for agricultural communities in Washington and is known as Agriculture, Fish, and Water. The U.S. Fish and Wildlife Service is considering the possible impacts and potential benefits from both of these State processes relative to bull trout recovery.

Biological Opinion on the Federal Columbia River Power System

On December 20, 2000, the U.S. Fish and Wildlife Service issued a Biological Opinion on the "Effects to Listed Species from Operation of the Federal Columbia River Power System" (USFWS 2000). The opinion identifies the need for continued research into the extent of bull trout use within the mainstem Columbia River. The Biological Opinion recognizes in all likelihood that as recovery actions are implemented bull trout will increase their use of the mainstem Columbia. Reasonable and prudent measures in the Biological Opinion are consistent with primary research needs identified by the Middle Columbia Recovery Unit Team. As recovery proceeds, the need for research to investigate problems in the mainstem Columbia River associated with fish ladder use, entrainment, spill, flow attraction, and water quality will need to be addressed through the formal consultation process.